Skills training
in medicine

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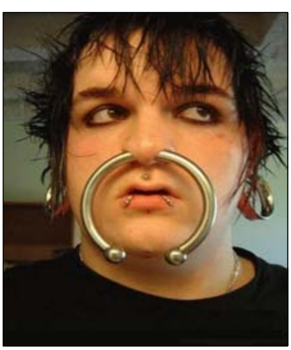
Challenges that confront our traditional teaching system



1. Mass education, changing attitudes (Internet generations…)

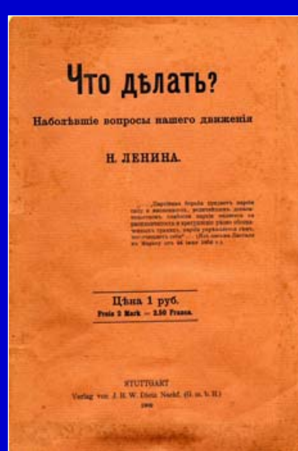
2. Patient safety

Challenges that confront our traditional teaching system

3. **Need to cover the rapidly changing technical aspects of medicine.**

4. **Proficiency in medical skills only comes from practice; the more the skill is performed, the more fluent the performance becomes…**

How to achieve proficiency and expertise (practice) in medical education ?



How to achieve proficiency and expertise in medical education ?

1. Master and Apprentice

2. Animal models

3. Simulation

I. Simulation and medicine

The beginning

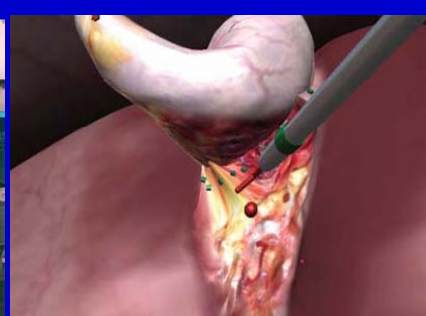
Stephan Zick (1639 - 1715)

The past

1928 “Link Trainer” (Edwin Link’s plane)
1960 Laerdal’s “Resusci-Annie”
1968 “Harvey” cardiology simulator
1988 ”Mannequin” (Stanford)

Today
High fidelity simulation and VR (Virtual Reality)

Immersion



Desktop

Haptics

1950's: U.S.A.F. develops the Tactual Sensory Control System (TSCS = human body's response to mechanical vibration)
1965: Ivan Sutherland and "Ultimate Display": "*If the task of the display is to serve as a lookingglass into the mathematical wonderland constructed in computer memory, it should serve as many senses as possible.*"
Project GROPE
(1967): Haptic display of molecular forces (2 DoF finger grip display) – GROPE II
(1976): Distant manipulator (3 forces, 3 torques hand grip display) – GROPE III
(1990): Molecular docking system (full 6 DoF hand grip display)


http://www-cdr.stanford.edu/touch/tele_projects/

Present – haptic music and painting


The vBow: Development of a Virtual Violin Bow Haptic Human-Computer Interface

Charles Nichols

Abstract

Keywords

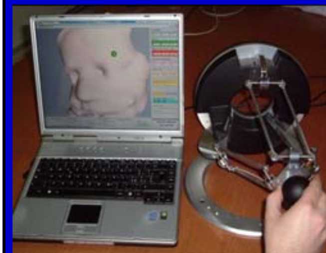
MOTIVATION

HARDWARE

Figure 1. The vBow, version 1.

Figure 2. The vBow, version 2.

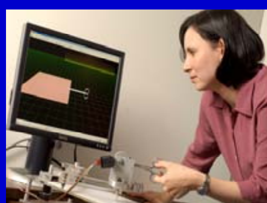

Haptic medicine



FeTouch
(Medical ultrasound imaging for 3D reconstruction)

HORUS
(Haptic Operative Realistic Ultrasound Simulator)

BoneSim
(Visuohaptic simulation of bone surgery)



www.nibib.nih.gov/.../eAdvances/29Jan07

Haptic telementoring system

Expert surgeon's motions are recorded during a procedure

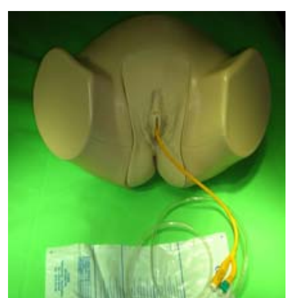
Data are used to develop a training simulation where novice surgeons practice by imitating the expert surgeon's gestures

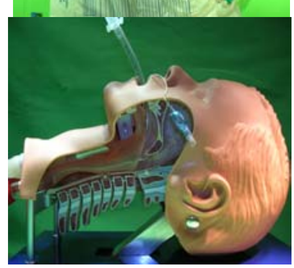
www.casit.ucla.edu/research_telementoring.htm

"Virtual Reality" with *"Augmented Reality"* (AR)

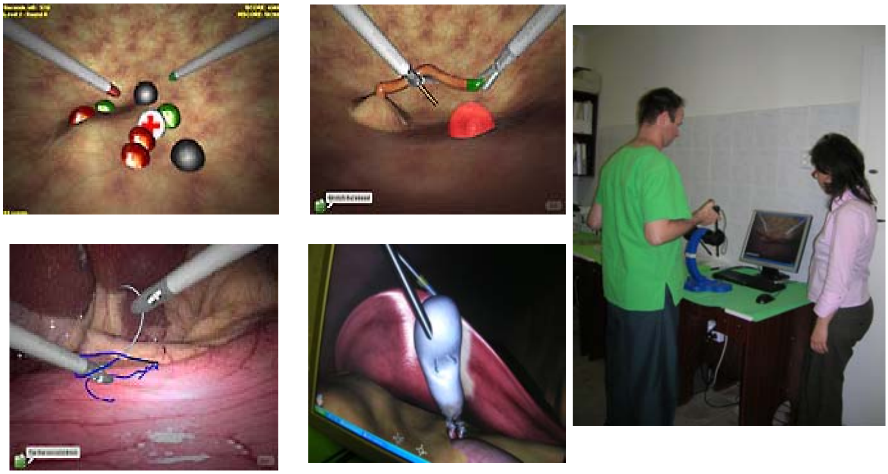
Augmented Reality (a) + Robotics (b) = „Automated" Surgery (c)

Szeged: Task trainers





Szeged: Virtual Reality



„Lapsym” VR system to teach minimally invasive surgery

Szeged: VR Haptics

„CathSym” haptic VR system to teach intravenous catheterization

Debriefing

Learner: proba

Case Scenario: Pedestrian Struck

Student 1

Score: 65

Unsuccessful Completion of Procedure

Procedure Time: 00:04:42

C-Band Time: 00:00:00

Cannulation Events

- **Vein Punctured**
- **Insertion Through Vein**
- **Rolling Vein: Vein Not Stabilized**
- **Recannulation**

Critical Errors

- **Procedure Completed in Appropriate Time**
- **Standard Precautions Performed Correctly**
- **C-Band Usage Incorrect**
  - Insertion made without constricting band
- **Catheterization Attempted**
- **Catheter Cannulation Error**
  - Needle re-cannulated
  - Catheter not threaded
  - No lock, or IV infusion attached to catheter
- **Site Preparation Correct**
- **No Site Contamination**
- **Equipment Disposed Incorrectly**
  - Gloves not disposed
- **Insertion Made at Allowable Site**
- **Patient identification performed correctly**

Debriefing

Learner: proba

Case Scenario: Right Lower Quadrant Pain

Student 1

Score: 84

Successful Completion of Procedure

Procedure Time: 00:02:34

C-Band Time: 00:01:30

Cannulation Events

- **Correct Cannulation**
- **Vein Punctured**

Critical Errors

- **Procedure Completed in Appropriate Time**
- **Standard Precautions Performed Correctly**
- **C-Band Usage Correct**
- **Catheterization Attempted**
- **Vein Cannulated and Correctly Threaded**
- **Flash Chamber Observed Correctly**
- **Site Preparation Correct**
- **No Site Contamination**
- **Equipment Disposed Correctly**
- **Insertion Made at Allowable Site**
- **Patient identification performed correctly**

Non Critical Errors

- **Appropriate Site Selected**
- **Patient Informed at Appropriate Time**
- **Incorrect Bevel Angle**
  - Needle inserted with the bevel down

Summary (1): Simulation = Education + Entertainment (EduTainment)

Part 2. Skill centers

Providing framework for expert tuition and feedback

”The promise of robotic-assisted surgery and the tradition of hand-sewn sutures come together under one roof, in a new surgical training center”
By Joanne Cavanaugh Simpson

JOHNS HOPKINS *Magazine*

”Launched a little over a year ago with $3.2 million in funding from U.S. Surgical Corporation, the lab has served over 1,500 Hopkins medical students, residents, and surgeons”   In: *The Cutting Edge, April 2003 Issue*

Skills training and skills centers

Editorial & Review: New England Journal of Medicine, 2006

Technical-Skills Training in the 21st Century

Rajesh Aggarwal, M.R.C.S., and Ara Darzi, M.D.

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

MEDICAL EDUCATION

Teaching Surgical Skills — Changes in the Wind

Richard K. Reznick, M.D., M.Ed., and Helen MacRae, M.D.

ORIGINAL REPORTS

Current Assessment and Future Directions of Surgical Skills Laboratories

Muneera R. Kapadia, MD, Debra A. DaRosa, PhD,* Helen M. MacRae, MD,† and Gary L. Dunnington, MD‡*

*Department of Surgery, Northwestern University Feinberg School of Medicine, Chicago, Illinois; †Department of Surgery, University of Toronto, Toronto, Ontario, Canada; ‡Department of Surgery, Southern Illinois University School of Medicine, Springfield, Illinois

Learners

The surgical skills laboratories at most surveyed institutions are geared toward resident education (96%, 26 responses). However, other learners using the laboratories include medical students (69%), nurses/physician assistants (42%), and individuals who require continuing medical education (57%).

The quality of instruction is assessed by several methods in the skills laboratories. The performance measures by simulation models (17 of 26, 65%) was the most common, followed by resident-completed evaluation forms (13 of 26, 50%). Some programs make use of faculty-completed evaluation forms (7 of 26, 27%) and OSATS (4 of 26, 15%). In 6 (23%) surveyed skills laboratories, no curriculum assessment is conducted.

TABLE 6. Specialties Using Skills Laboratories

Responses: 26	
Anesthesiology	3 (12%)
Cardiothoracic	3 (12%)
ENT	4 (15%)
Family practice	3 (12%)
General surgery	22 (85%)
Internal medicine	5 (19%)
Neurosurgery	2 (8%)
Obstetrics/gynecology	14 (54%)
Orthopedics	6 (23%)
Plastic surgery	4 (15%)
Transplant	1 (4%)
Urology	10 (39%)
Vascular	8 (21%)
Other	7 (27%)

TABLE 5. Skills Laboratory Modules by Postgraduate Year

	Postgraduate Year						
Modules (Responses: 25)	**1**	**2**	**3**	**4**	**5**	**>5**	**Total**
Asepsis and instrument handling	17	4	1	0	0	0	18
Instrument handling, knot tying, suturing	20	8	8	6	7	3	23
Tissue handling, dissection, wound closure	20	11	8	5	5	1	21
Catheterization—urethral, suprapubic	4	0	0	0	0	0	4
Airway management	15	8	3	1	1	0	15
Chest tube and thoracentesis	15	4	0	0	0	0	15
Central line insertion	13	5	1	1	1	0	13
Minimally invasive surgery (Basic)	23	19	15	4	4	2	25
Minimally invasive surgery (Advanced)	5	6	14	18	17	7	24
Surgical biopsy and electrosurgery	12	4	0	1	0	0	13
Advanced tissue handling and skin closure	9	3	3	2	1	0	11
Vascular control (Basic)	7	2	3	1	0	0	11
Vascular control (Advanced)	4	3	5	4	3	0	10
Anastomosis (Hand sewn)	11	9	9	5	4	1	16
Anastomosis (Stapled and hand sewn)	8	9	7	5	3	1	14
Operating room team training	6	5	5	4	4	3	7

American College of Surgeons (ACS) guidelines

Table 2-3. Education Institutes accredited at Level I by the American College of Surgeons

1. Minimally Invasive Surgery Education Center, University of California, Irvine School of Medicine, Orange, California
2. Simulation and Skills Center of the Carl J. Shapiro Institute at Beth Israel Deaconess Medical Center, Boston, Massachusetts
3. William Beaumont Hospital, Royal Oak, Michigan
4. The University of New Mexico Health Science Center BATCAVE Medical Simulation Program, Albuquerque, New Mexico
5. Center for Medical Education & Innovation at Riverside Methodist Hospital, Columbus, Ohio
6. Institute for Clinical Simulation and Patient Safety, Temple University School of Medicine, Philadelphia, Pennsylvania
7. Southwestern Center for Minimally Invasive Surgery, UT Southwestern Medical Center, Dallas, Texas
8. Institute for Surgical and Interventional Simulation (ISIS), University of Washington, Seattle, Washington
9. Centre of Excellence for Surgical Education & Innovation, University of British Columbia, Vancouver, British Columbia, Canada
10. University of Toronto Surgical Skills Centre at Mount Sinai Hospital, Toronto, Ontario, Canada
11. Department of Surgery Education Institute at Stanford, Stanford University, Stanford, California
12. Northwestern Center for Advanced Surgical Education, Northwestern University, Chicago, Illinois
13. Louisiana State University Health Sciences Center, New Orleans Learning Center, New Orleans, Louisiana
14. Maryland Advanced Simulation, Training, Research and Innovation Center, University of Maryland, Baltimore, Maryland
15. Baystate Simulation Center, Baystate Medical Center, Springfield, Massachusetts
16. University of Michigan Clinical Simulation Center, Ann Arbor, Michigan
17. Mayo Clinic Multidisciplinary Simulation Center, Rochester, Minnesota
18. Penn State Milton S. Hershey Simulation Center, Pennsylvania State University, Hershey, Pennsylvania

Ajit K. Sachdeva, Carlos A. Pellegrini, Kathleen A. Johnson. Support for Simulation-based Surgical Education through American College of Surgeons – Accredited Education Institutes. World J Surg (2008) 32:196–207

American College of Surgeons (ACS)

Competencies

TABLE 1. Forty Eight Topics Amenable to Teaching by Simulation

1. Knot tying
2. Suturing simple lacerations
3. Suturing complex wounds
4. Excision of skin lesion
5. Instrument identification and handling
6. Tissue handling
7. Central line placement
8. Arterial line placement
9. Abscess drainage
10. Open wound care/negative pressure dressings
11. Chest tube and thoracentesis
12. Airway management
13. Laparoscopic skills 1 (instruments, trocars, towers, basic motion)
14. Laparoscopic skills 2 (cholecystectomy, knot tying)
15. Laparoscopic skills 3 (advanced techniques)
16. Anastomosis, bowel manipulation
17. Enterotomy
18. Bowel anastamosis stapled & sewn
19. Basic endoscopy
20. …..
21. ….
22. …

Jeffrey G. Chipman, Robert D. Acton, Constance C. Schmitz: Developing Surgical Skills Curricula: Lessons Learned from Needs Assessment to Program Evaluation. Journal of Surgical Education 66/3 • May / June 2009

American College of Surgeons (ACS)

Exams and evaluations (examples)

TABLE 1. Proficiency Levels

Task	Task Name	Goal Time (Sec)	Best Time (Sec)	Allowable Errors
FLS task 1	Peg transfer	57	33	No pegs dropped outside field of view
FLS task 2	Pattern cut	68	49	All cuts within 2 mm of either side of line
FLS task 3	Endoloop	22	14	Up to 1 mm accuracy error
FLS task 4	Extracorporeal suture	106	85	Up to 1 mm accuracy error; no slippage
FLS task 5	Intracorporeal suture	65	49	Up to 1 mm accuracy error; no slippage
VR task 1	Camera navigation 0 degree	<52	<46	Accuracy > 90%
VR task 2	Camera navigation 30 degree	<73	<58	Accuracy > 90%
VR task 3	Hand–eye coordination	<20	<18	Accuracy > 90%
VR task 4	Clip application	<54	<51	Accuracy > 80%
VR task 5	Grasp and clip	<57	<51	Accuracy > 80%
VR task 6	Ball drop	<77	<57	Must collect > 8 balls
VR task 7	Cutting	<32	<24	Safe retraction > 90%
VR task 8	Cautery application	<124	<112	Efficiency > 82%
VR task 9	Object translocation	<180	<100	# dropped objects < 30

Dimitrios Stefanidis, Christina E. Acker, Dawn Swiderski, B. Todd Heniford, Frederick L. Greene: Challenges During the Implementation of a Laparoscopic Skills Curriculum in a Busy General Surgery Residency Program Journal of Surgical Education 65/1 • January/February 2008

Institutes of Surgical Research, Hungary



Budapest

From September, 2010



Skills courses for 3rd–5th year medical students
Institute of Surgical Research, University of Szeged

‘Basic surgical techniques’

A1. MODULE – Asepsis skills
A2. MODULE – Instrumentation skills
A3. MODULE – Knot tying skills (Suture Tutor Computer Program).
A4. MODULE – Suturing skills (Suture Tutor Computer Program).
A5. MODULE – Bleeding skills
A6. MODULE – Wound skills

‘Monitoring skills’

B1. MODULE - Injection skills (Cathsym VR)
B2. MODULE - Cannulation skills (Cathsym VR)
B3. MODULE - Hemodynamics (CVP, arterial pressure, blood flow, cardiac output)
B4. MODULE - Respiratory system
B5. MODULE - GI system (NG tube, tonometry)
B6. MODULE - Urinary tract (catheterization)

‘Advanced medical skills’

C1-2. MODULES - Advanced suturing (Minor Surgical Skills Program)
C3-4. MODULES - Abdominal, thoracic drainage (insertion of chest tube), tracheostomy
C5-6. MODULES - Minimally invasive surgery, basics (Box trainer, LapSym VR system)

Postgraduate level

3-weeks practical courses for surgical residents

'Microsurgery'

D1. MODULE – Basic microsurgical skills (graduate level)
D2. MODULE – Advanced skills for residents (vessel and nerve anastomoses in vivo)

'Surgical Techniques' 3-weeks' compulsory course for surgical residents

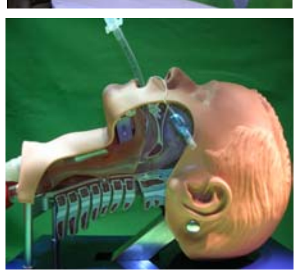
E1. MODULES (5 days) 'Traditional Surgical Skills'
E2. MODULES (5 days) 'Minimally Invasive Surgery'
E3. MODULES (5 days) = D2 = 'Advanced Microsurgery'

Course materials (*Surgical techniques*; *Monitoring in medical practice*, *Magnified surgery*, *Practical skills syllabus*) may be downloaded from http://web.szote.u-szeged.hu/expsur

Summary (2)

Simulation and Skills Training at the University of Szeged

VR systems Task trainers *In vivo* models Microsurgery Minimally invasive surgery



Background (3)

Simulation and Skills Training - University of Timisoara

Microsurgery

Task trainers

***In vivo* models**

Background Summary (3)
The INTERREG HURO-0602/086 project

INTERREG project Szeged - Timisoara

2007. 06. 01. - 2008. 05. 31

Aims

1. To build an infrastructure where tools of telemedicine can significantly facilitate the transfer of knowledge. Up-to-date communication devices could be used

- **to connect the multi-centric educational work,**
- **to realize cooperation between teachers and students alike,**
- **to multiply the results.**

2. The running of complementary skills systems:

- **provides an exceptional possibility to build inter-regional intellectual connection,**
- **allows for the approximation of a considerable segment of the higher education of the two cities**
- **strengthens partnership and mobility.**

Quantitative results

Course	Nr of students / courses
A	9
B	7
C	6
D1 (basic level)	Through telemedicine
D2 (advanced)	Through telemedicine
E (residents)	2 courses with 15 students

Opinion of Romanian medical students and residents

(Anonymous, voluntary, questionnaire-based survey, 5-grade scales)

	Graduate students	Postgraduates
Organization of practicals	4.62	4.75
Arousing interest	4.62	4.87
Possibility of active participation	4.87	4.62
Quality of lectures	4.75	4.81
Quality of practicals	4.75	4.75

Quantitative results
Telemedicine - telementoring system

Qualitative results

Qualitative results
(….good connections)



…

…

Publication edited in the context of the project entitled: "Telemedicine and video-microsurgery in the creation of an regional cross-border real-time teaching and medical assistance system"- with the financial aid of the European Union through the Romania-Hungary PHARE CBC 2004/INTERREG IIIA Program
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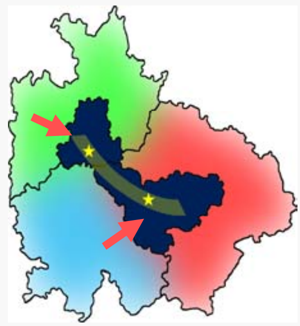
Future (?)
Skills training programs (embedded into the curricula) = driving forces for equilateral education development



Thank you!